



Research Article

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The Aspect of Mobility and Connectivity While Assessing the Neighbourhood Sustainability

Špela Verovšek*

Tadeja Zupančič¹

Matevž Juvančič¹

Simon Petrovčič¹

Matija Svetina²

Miha Janež³

Žiga Pušnik³

Iztok Lebar Bajec³

Miha Moškon³

¹University of Ljubljana, Faculty of Architecture

²University of Ljubljana, Faculty of Arts

³University of Ljubljana, Faculty of Computer and Information Science

*Corresponding Author

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Abstract

The rapid evolution of information and communications technologies has brought the potential held by urban analytics up to a higher level and thus promises more well-informed decisions, including advances in the assessment methodologies and monitoring based on existing data and its reuse. The paper provides an insight into an ongoing national research project examining the assessment methodologies and data integration for the purpose of monitoring the progress as regards sustainability and quality in urban environments. Specifically, we focus on the level of the neighbourhoods; by measuring the extent to which the built environment comprehends the required characteristics and configuration for efficiency, or contribute to quality living and sustainability. Current study covers the aspect of efficient mobility and connectivity, revealing the potential of the location-based data provided by mobile devices and associated infrastructures. While such data are widely recognised as a beneficial source of information in various fields and solid advances have been made in both analytics and modelling, little progress has been seen in exploiting that potential as regards sustainability assessment tools. This study examines the viability of indicators addressing travel time reliability throughout the empirical testbed, exemplified by six strategic routes associated with three neighbourhoods in Ljubljana, Slovenia. The paper summarizes current progress of the study.

Keywords: sustainability assessment, sustainable mobility, travel time reliability, neighbourhoods, Google APIs

1. Introduction

Sustainability in urban environments and the question of quality of living have remained key challenges in our cities which express also through the remarkable expansion of monitoring methodologies or related literature. Over the recent years considerable efforts have been invested in methodological challenges that range from outlining the sustainability coverage, designing the suitable indicators for monitoring (Kaur & Garg, 2019) or advancing the methods of data integration and data reuse for more efficient and well-informed decisions in urban planning or renewal. The rapid evolution of *Information and communications technologies* has brought the potential held by urban analytics up to a higher level and thus promises more well-informed decisions, including ones based on existing data and its direct reuse.

A massive amount of data is generated and collected every moment of the day by the sensors of millions of devices, machines and smartphones in our daily routines. How data and IT knowledge can be harnessed to generate insights for enhanced decision-making and urban planning is a pressing topic for practitioners, academics and government agencies alike, situating urban analytics within an emerging interdisciplinary arena with strong tendencies for making crucial shifts in data processing. However, the questions arise whether our capacities allow us to become the advocates of a transformative change and if we possess sufficient knowledge and methods to thereby foster sustainable urban development with it.

Current interdisciplinary research conducted by the Faculty of Architectures in liaison with the Faculty of Computer and Information Sciences and the Department of Psychology is examining the potentials and possible advances in the field of data-driven support for more balanced decisions as regard the sustainability and quality in the neighbourhoods. We do that through the development of strategies and methodologies used for neighbourhood sustainability assessment (NSA). In our previous research project (Verovšek et al., 2018) we encountered numerous obstacles related to data accessibility, data resolution and data integration, accompanied by a critical lack of metrics for addressing less quantifiable aspects of urban quality, or reusing the existent locational data sets available. To limit the extensiveness of the topics under the term “sustainable”, we are selectively addressing different thematic scopes in several testbeds. Currently we examine the indicators of mobility and connectivity as features that significantly impact the efficiency, quality and liveability of neighbourhoods. Indicators related to connectivity and accessibility are important also from the aspect of, how an individual perceives his wellbeing, place of dwelling, the liveability and sustainability of it (Cervero et al., 2017). Moreover, travel patterns, traffic flow and road occupancy directly affects environment and economy thus, the measures related to that, are recognized to be an essential part of the NSA instruments. To this point the location data are widely acknowledged as a beneficial source of information, they offer an insight into understanding how audiences move and behave in real time (Anejionu et al., 2019). Although solid advances have been made in both travel analytics and modelling, little progresses have been seen in exploiting that potential as regards sustainability assessment tools.

Two main reasons make targeting the objectives of this research important: (i) to offer urban decision-makers a supporting instrument able to inform and substantiate spatial interventions in the renovation process of different neighbourhoods through a consistent and standardised framework of key indicators/criteria; (ii) to give spatial users and residents a clear insight into the state of the neighbourhood, its sustainability and quality, while also encouraging them to increase their commitment to improvements (through various ways like changing non-sustainable habits, engaging them in monitoring, contribution of data etc.)

2. Neighbourhood Sustainability Assessment (NSA) and Monitoring Liveability

The question of the quality and sustainability optimisation of the existent neighbourhoods has proven to be particularly relevant in combination with data-driven decision-making (Bibri, 2019) and related methodologies. Rerecord-keeping and monitoring the progress of neighbourhoods with respect to various aspects of sustainable development as well as the short- and long-term comparability of

successful revitalisations is an emerging need.

In order to contextualise the sustainability and sustainable development of the built environment, many assessment tools have been developed in past decades. This has occurred at different spatial scales, from the single building scale to the neighbourhood and city scale so as to facilitate decision-making and improve the sustainable performance and organisation of various spatial entities (Zheng et al., 2017). The “neighbourhood scale” concept is not tied to cohesive geographical size and may be ambiguous due to neighbourhoods’ scale variability (Lewicka, 2010); however, the concept is intuitively understood and widely recognised from an interdisciplinary research perspective including sociological, economic, geographical, or urban planning (Berčič et al., 2018; Martí et al., 2019). Thus, the neighbourhood, district, local community are expressions that correlate to the scale of human interaction, and dwelling and as such appear as a solid concept also in the terminology of the sustainability assessment.

Therefore, neighbourhood sustainability assessment (NSA) tools are instruments that evaluate the sustainability performance of a given mesoscale entity such as a neighbourhood or district against a set of criteria and corresponding indicators (Sharifi and Murayama, 2015). The composed indicators help to disaggregate the complex phenomena and impact chains in built environments and offer a practical framework for detecting situations and understanding the relationship with more abstract criteria and goals like environmental compatibility, economic efficiency and quality of dwelling. Compact sustainability assessment procedures were initially developed for impact assessment at the level of individual buildings and gradually developed to the neighbourhood or district scale. The last decade has witnessed the release of several urban sustainability certification standards, especially ones focused on the spatial mesoscale. More than a few reviews (e.g. Sharifi & Murayama, 2015; Reith & Orova, 2015; Adewumi et al., 2019; Kaur & Garg, 2019) note the most widely recognised systems, such as LEED ND (Leadership in Energy and Environment Design – Neighbourhood Development; United States), BREEAM Communities (Building Research Establishment’s Environmental Assessment Method – Communities; UK), DGNB District (German Sustainable Building Council for District; Germany) CASBEE UD (Comprehensive Assessment System for Building Environment Efficiency – Urban Development; Japan), HOE2R (HQE High Quality Environmental and Economy in Regeneration standard, European Union), SCR (Sustainable Community Rating, Australia) etc. Most of these tools are similarly structured: the instruments follow a system of multidimensional criteria and indicators, wrapping up the scores by hierarchically arranging the goals to facilitate evaluation, monitoring and benchmarking. The indicators are commonly clustered according to an initial three-silo approach – gathered around economic, social and environmental dimensions/pillars on the highest hierarchical level, which impairs one’s ability to understand the interdependence of these three domains and related impacts (Cohen, 2017). Similarly, four-part or five-part (daisy) concepts are introduced in some cases, comprising additional dimensions of technical/operational and institutional. In the next hierarchical step, NSA tools typically follow categories, often denoted as themes¹, which further label the concerns of sustainability and liveability². Each theme is further divided into sets of criteria,

¹ A plethora of reviews reveal the most frequently associated categories: natural resources and energy (also environmental resources, ecological concern, environmental efficiency etc.), built environment and organisation (also land use, urban pattern and building typology etc.), transport and mobility (also connectivity, mobility and accessibility, transportation etc.), identity and cultural heritage (historical continuity), health and safety (safety of open spaces), quality of public spaces (also the liveability), economic value and marketing (economic viability), community engagement (social cohesion and participation, social networking and interaction) and similar.

² Liveability refers to the attributes people value about the place they live in, which contribute to the experience of welfare or a high life quality (Andrews, 2001). It relies on the quality of urban settings and design of built environments, thus the ability to plan cities that respond to individual requirements while meeting sustainability goals is one of the most important purposes of contemporary society. As a concept, liveability is not an independent variable; to some extent, it depends on the ‘triple-bottom’ sustainability model. As such, liveability is a specific, nuanced and qualitative component of the broader concept of sustainability (Szibbo, 2016).

indicators and sub-indicators. NSA frameworks are often strongly linked to their original regional contexts and thus not necessarily transferable to other environments (Sharifi and Murayama, 2015). In order to open up their use and make them more universal, some tools provide two types of indicators: prerequisite/mandatory indicators and optional indicators. In addition, mandatory indicators can have different reference values (benchmarks) and the weighting scheme can be dissimilar in order to keep the evaluation relative to the regional context and to be able to distinguish between different cultural or local backgrounds. However, to make assessments reliable, comparable over time or transferable as regards the location the biggest challenge is to clearly identify the generic and specific indicators to be used and embedded in the frameworks or to define interchangeable indicators or suitable weights. The literature provides little by way of solid answers to these issues, instead pointing out specific scopes and indicators that seem to be more important than others in certain thematic areas.

Another crucial problem that is often identified is data availability. One can establish and propose a perfectly suitable indicator system for the assessment, but that is of little use if data are not accessible or available for certain scales or frames to perform the analyses. In the reviews of assessment tools and their operability (e.g. Zheng, 2017; Boyle et al., 2018; Chao et al., 2020), the lack of data for quantitative evaluation was most commonly fixed by performing qualitative assessments based on a surveying methodology³ or trained expert estimation. Another solution often used is simple interpolations where a wider area (or time lap) is relied on to proxy for performance against an indicator or more indicators. Both can critically decrease the geospatial resolution and eloquence of the data, resulting in an assessment of weak informative strength. Paradoxically, on one hand we are facing an increasing amount of captured and gathered urban spatial data from various sources while, on the other, we encounter significant data scarcity, especially of small-scale, micro-urban and fine-grained records that allow us to theoretically define and track the NSA tool parameters. For this reason, we aim to further develop or modify the existing NSA indicators so that they reflect information relevant to specific aspects of sustainability and quality of dwelling, while also constituting solid pillars for data acquisition and analysis.

3. Sustainable Mobility Indicators

Due to the wide thematic coverage of assessment frameworks and accompanying extensive range of possibly important indicators, databases and data types, our work programme is set as a series of testbeds in initially separate theoretical and applied assemblies. This workflow allows us to study in detail selected data assemblies and actual IT-supported solutions. Our current interest concerns traffic and mobility indicators as a very important component of sustainability assessments. The second reason for delving into this thematic scope is the well-articulated prospect of data support in this thematic field, also feasible on the level of neighbourhood scales.

The addition of the mobility as a concern in the context of sustainability assessment tools gave rise to a new discursive practice devised by academic research, government agencies, and transportation agencies and institutions. The World Business Council for Sustainable Development (WBCSD) formulates the process of developing urban sustainable mobility as follows: "The ultimate goal is to accelerate and extend access to safe, reliable and comfortable mobility for all whilst having, zero traffic accidents, low environmental impacts, affordability, and reduced demands on energy and time/..." (WBCSD, 2018).

The Directorate for the Mobility and Transport of the European Commission in liaison with the

³ Conducting a city-wide household travel survey requires extensive resources. Therefore, even developed cities and countries perform travel surveys only every 5 or 10 years. As a result, travel survey approaches usually lack instantaneity and continuity (Yin et al., 2020).

WBCSD has developed a comprehensive set of practical and reliable indicators (SUMI⁴) that support cities in performing a standardised evaluation of their mobility system, practices and travel patterns, which have to some extent also proven to be a good starting point for neighbourhood sustainability assessments. The indicator set specifically adapted for European cities (SMP2.o Sustainable Mobility Indicators) comprises the following core indicators: affordability of public transport for the poorest group indicator, accessibility of public transport for mobility-impaired groups indicator, air pollutant emissions indicator, noise hindrance indicator, road deaths indicator, access to mobility services indicator, greenhouse gas emissions indicator, congestion and delays indicator, energy efficiency indicator, opportunity for active mobility indicator, multimodal integration indicator, satisfaction with public transport indicator, traffic safety modes. These are further followed by ‘non-core indicators’: quality of public spaces indicator, urban functional diversity indicator, commuting travel time indicator, mobility space usage indicator, and security indicator (reported perception of crime-related security in the city transport system (including freight and public transport, public domain, bike lanes and roads for car traffic and other facilities like car or bike parking). Other tools for assessing sustainable mobility that have been developed cover similar thematic scopes (Gillis et al., 2016) by which decision-makers can better understand the sustainability values, or the lack thereof, and further monitor or compare them with regard to the geolocation or time cross-sections.

Indicators mentioned above or identified in other sources are proved to be not well suited to neighbourhood-like scales. While promoting quantitative metrics with well-quantifiable and compact data use, the great majority⁵ of indicators is still forced to rely on the less efficient surveying methodology, indirect use (Verovšek et al., 2016) or imply an adaptation of the simple spatial or time-based linear interpolation methods, which considerably decreases the eloquence of the data. On top of extensive data requirements, such metrics are costly to obtain. For example, audits and surveys require a massive deployment of resources, and are only standardised at a country level (Kraemer et al., 2019), hindering the correct quantification of mobility indicators on a local scale.

For this reason, our effort was to delve into the opportunities given by location data. Location data is a term associated with geographical information about a specific mobile device’s position related to a time identifier (Ewen, 2019). Location data can be aggregated and analysed to provide significant scale insights into behaviour and movement. One such opportunity is represented by the use of ‘Floating Car Data’ – records resulting from timestamped geo-localisation and speed data directly collected by moving vehicles and their users⁶, as a basis for estimating various parameters like actual vehicle travel times on selected routes. Such data are provided, for example, by services such as Google Maps, Waze, and similar, usually against payment. Compared to classic data queries, as Kraemer (2019) puts it, such data sources – being constructed from mobility information alone – are significantly less expensive to compile (involving only computer-processing cycles) and are available in real time. Recent comparative studies (e.g. Kumarage, 2018) examining the reliability and consistency of Google Direction services has proved significant accuracy in travel times compared to empirical records. While radar, loops, video detection, infrared traffic loggers and other point based detection systems can now provide very accurate traffic data, many of the technologies require significant equipment and construction costs (Chase et al., 2013), and therefore the new technologies offer potentials also in terms of the NSA assessment and data availability.

⁴ SUMI is a service contract for the European Commission’s Directorate-General for Mobility and Transport providing technical support related to sustainable urban mobility indicators (MOVE/B4/2017-358). The project helps urban areas using the “SMP2.o Sustainable Mobility Indicators” developed by the World Business Council for Sustainable Development (WBCSD, 2018).

⁵ The study conducted by Bongardt et al. (2011) proved by comparing and analysing 16 sustainable mobility assessment tools that more than 70% of revised indicators struggle with a significant or large lack of available data.

⁶ Records rarely directly relate to cars/vehicles (e.g. GPS-equipped cars), but to the mobile devices of the car users – adopting the cellular network data, every switched-on mobile phone works as a traffic anonymous sensor.

4. The Travel Time Reliability Indicators

As regards our objectives to primarily address sustainable mobility with respect to quality of dwelling and liveability, we decided to consider measures of travel time reliability on road motorised trips. The importance of travel time reliability in traffic management, monitoring, benchmarking and network design has received considerable attention in the past decade (Zheng, 2017). It refers to indicators assessing consistency or dependability in travel times, as measured day to day or across different times of the day (Federal Highway Administration, 2006) and essentially applied to any travel mode. Vandervalk et al. (2014) define it as the variability in travel times that occurs for a specific trip or route over the course of time and the number of times (trips) that either ‘fail’ or ‘succeed’ according to a predetermined performance standard or schedule. While being a highly valued characteristic among travellers and commuters, travel time reliability affects their participation in activities and plays a decisive role in perceptions of choice and well-being. Although the value of travel time has for many decades been considered the main factor in travellers’ perceptions and hence drivers’ route choice decisions, researchers have more recently postulated that these travel time models may have been leaving out reliability and certainty considerations (Chepuri et al., 2019) of importance for time management (individual trip planning) and modern travel patterns. In fact, Lyman et al. (2008) state the consistency of travel times along a given corridor may be of much more important than the actual travel times.

By considering on-road travel time reliability, we look at the question of the predictability of planned or executed trips associated with the neighbourhood/s under consideration. These metrics are important for providing a realistic assessment of how consistent and predictable the traffic situations are on certain routes – in our case, routes related to selected neighbourhoods and targeted destinations within the city. While travel times along a certain route on a working day often vary by the departure time during the day (differences in morning and afternoon peak hours), most travel time variability indicators seek rather than capture changes and deviations from the ‘normal’ or ‘expected’ at a certain time of the day. In relation to these targets, different kinds of solid measures have in recent years been proposed and applied to assess traffic performances and reliability (Chepuri et al., 2019) such as standard deviation, planning time index, buffer index, frequency of congestion, coefficient of variation, skew and width of travel time distribution, and others.

4.1 Testbed – selected neighbourhoods and routes in Ljubljana

In order to observe and reflect on such reliability indicators in terms of NSA assessments, we established a testbed based on three neighbourhoods in the city of Ljubljana (Fužine, Savsko naselje, Soseska Zeleni Gaj) and six independent routes. Each neighbourhood was set as a route origin for two travel trips – one heading to the destination point in the city centre and one heading to the commercial service/shopping centre on the outskirts of the city. The two destinations were selected as the strategic points of services that are important points of interest on the daily bases. The route variations were disabled to meet the comparable measurements. The reverse trips (back to the neighbourhoods) were not examined at this phase.

Table 1. Six routes based on three neighbourhoods in the city of Ljubljana (origins) and two strategic points (destinations). Route links provide with detailed geolocation and waypoints, mapped in Google directions.

		DESTINATIONS	
		Center, PH Kongresni trg 1 46.050664, 14.503503	BTC, Šmartiska 152 46.064207, 14.546801
ORIGINS	Nove Fužine 40, 46.054298, 14.561429	route 0 - link	route 1 - link
	Savsko naselje, Linhartova 64 46.064808, 14.520726	route 2 - link	route 3 - link
	Soseska Zeleni Gaj (F6.2) 46.042992, 14.462390	route 4 - link	route 5 - link

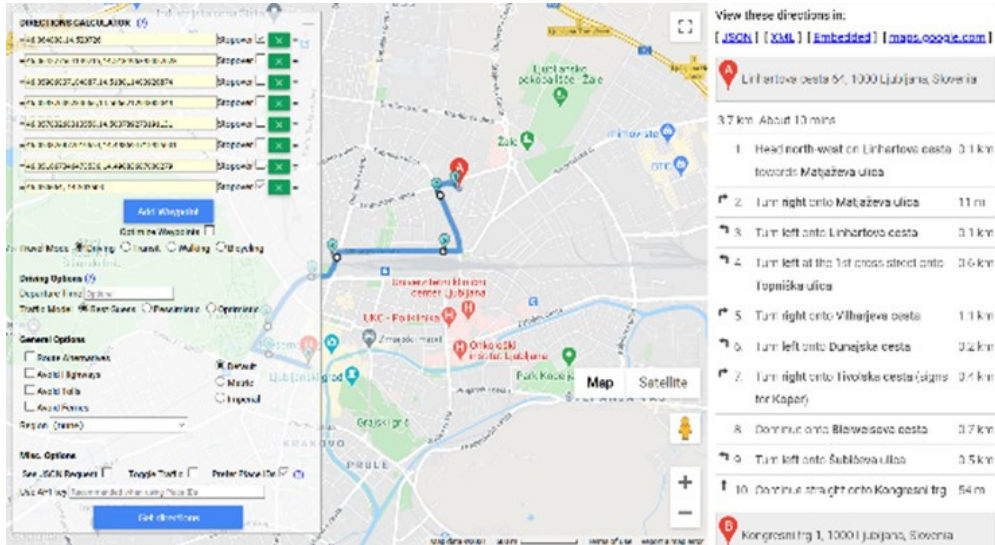


Figure 1. An example of the route setting: each route was defined and mapped by the Google Directions API interface, using latitude/longitude coordinates to identify the origins and destinations with intermediate waypoints to repeatedly select exact route.

The anonymous mobility patterns, more specifically the on-road travel times, were aggregated by Google’s Directions API⁷ combined with the Real-time weather API, to capture the travel times for selected routes during 3-week periods. Travel times on the selected routes were collected by the 10-minutes intervals 24/7. Our particular interest was dedicated to working days, this is, from Mondays to Fridays, when most of the routine trips are accomplished. Accessing the Directions service we used a call-back method to execute upon completion of the requests.

Although much attention was paid to the selection of data-capturing periods, to ensure representative situations on roads we faced certain unexpected impacts of Covid-19 regulations. The sample of days included in the examination period will be extended during the next few months after the regulation ceases to avoid declinations in data sets caused by the traffic situations thus imposed.

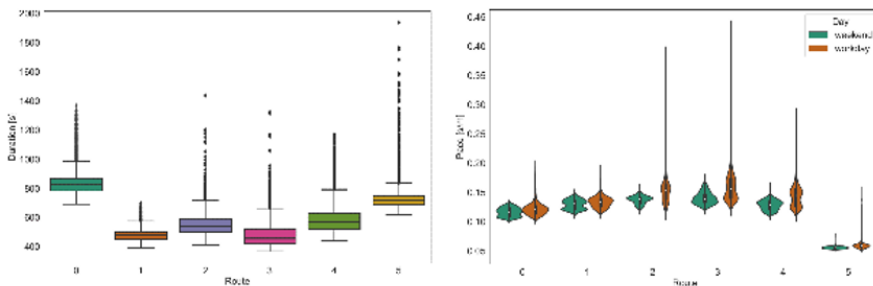


Figure 2. Comparison of the routes (0-5) – travel times distribution boxplot (duration in seconds) and pace distribution violinplot by workday/weekend, (exemplary data set; analyses: Moškon, M.).

⁷ Google’s location APIs More at: <https://developers.google.com/maps/documentation/javascript/directions>

According to the data captured, we first proceed with the descriptive analysis and distributions examination; further-on cosinor-based methods for detection and interpretation of the rhythmicity and variability of travel times were applied. In order to examine, visualise and model the traffic daily flow dynamics, considering also weekday-to-workday dynamics, the travel times were analysed using CosinorPy package (Mořkon, 2020).

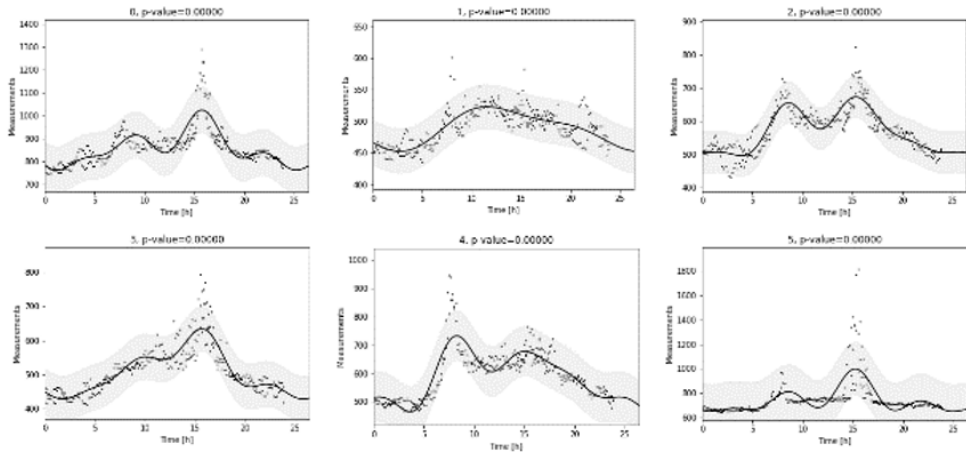


Figure 3. An example of the preliminary analyses: comparison of the routes as regards travel times variability during weekends; abscise: hour of the day; ordinate duration in seconds, (analyses and visualisation: Mořkon, M.)

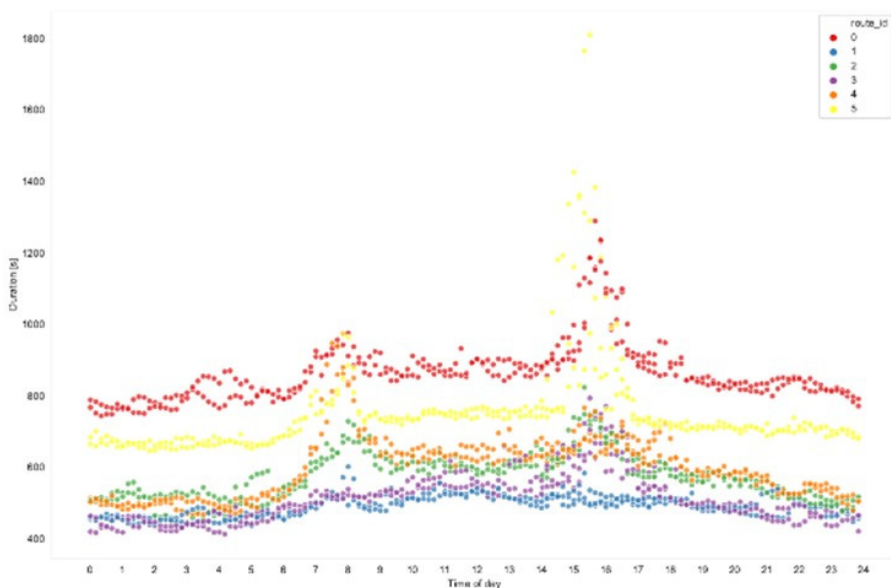


Figure 4: Comparison of the routes' trip durations during the working days; actual durations (exemplary data set; analyses and visualisation: Mořkon, M.)

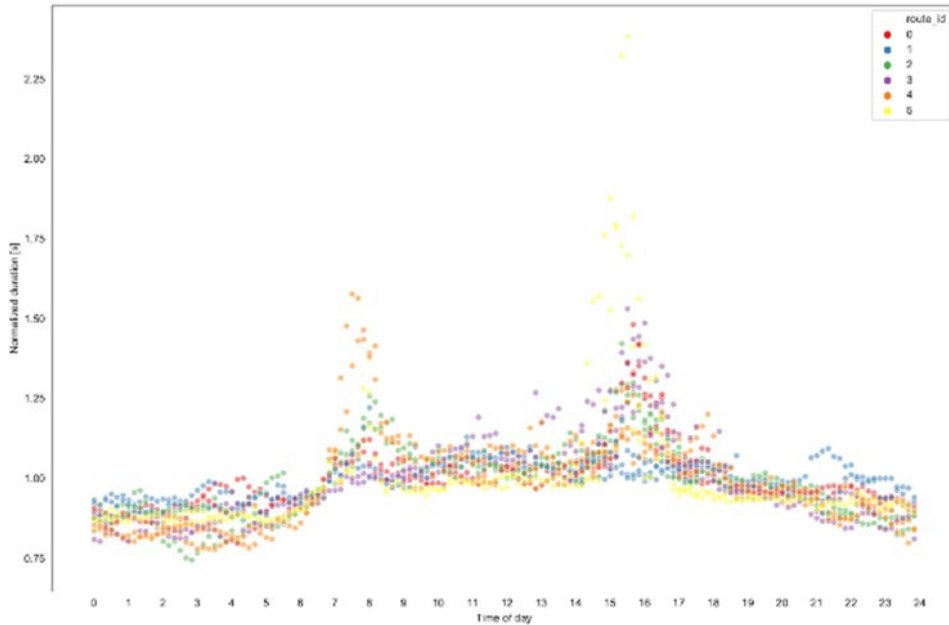


Figure 5: Comparison of the routes' trip duration during the working days; normalised values (partial data set; analyses and visualisation: Moškon, M.)

Current partial results reveal that travel times reliability fluctuates significantly both temporally (intra and inter days) and spatially (among the routes with regard to the origins in the neighbourhoods and among routes with respect to the destination). Traveling on certain routes in certain intervals would make one experience relatively high levels of time loss and uncertainty due to the increased travel time variability.

As predicted, travel time uncertainty is most strongly expressed in the two peak-hour periods (morning and afternoon peak) when distribution of the trip durations varies the most. Not all the routes have similarly expressed peaks, which make the selection of the time period within the day, important but difficult to meet the comparable conditions. The questions at this point are related to the representatives of the time slots taken for the NSA indication purposes, which is important to reduce the data sets (and resources used) yet necessary for the relatively corresponding results. In general, time-based sampling during the day has a large effect on the travel time variability calculated. As such daily peaks can affect direct comparison across segment types. The ideal comparison should thus include 24 hours of the day, or to avoid night discrepancies, 16 hours reference; however this hides to some extent the problems related to the peak hours exclusively, when numerous people experiences it as most stressful and time consuming.

Another aspect to consider while selecting a consistent method for calculating and interpreting travel time reliability, revealed to be the importance of the free-flow values and their estimation. For instance, buffer index or semi-standard deviation⁸ are both viable and convenient indicators, both requiring the free flow travel rate as a reference value for calculation. This reference is also

⁸ The semi-standard deviation is a one-sided statistic that measures deviations from a reference value. In the case of travel time distributions, the reference value is typically the free flow value and the deviations are only calculated for observations where the travel rate or travel time is higher than free flow (Chase et al., 2013, 9).

advantageous when non-recurring events needed to be identified. Typically traffic follow a daily pattern; however reliability can be often influenced by non-recurring or unexpected events such as weather, construction work or incidents (Chase et al., 2013), which in case of sampling, might bring biased insight. Therefore, it is important to balance their impacts, by also referencing to the free-flow values (and other means) in order to get a realistic and comprehensive picture of the reliability measure in a certain time period.

In any case travel time reliability measure as indicator within the NSA system should provide additional information as regards the connectivity to decision makers and residents, rather than restating typical performance measures. From the aspect of the neighbourhood resident, the important simplified measure of quality would represent the difference between the free flow and the average flow on a certain route during the day, which in other words mean – what is the average surplus time needed seating in the car – in comparison to “no congestion” travel rate – on a certain routine trip to work or shopping, made by a resident on a daily bases. And furthermore, what is the reliability of the average travel times spent for this daily routine trips, meaning – how much extra time shall one reserve for the trip to allow for traffic delays and to make it “on time”. Such questions might seem trivial on the first glance, but are actually very important elements as regard the living quality in certain neighbourhood and its actual connectivity/accessibility to strategic points in the vicinity.

4.2 Further steps

Within our next steps in this study we intend to first strengthen the empirical data by extending the examination period and data-capturing in the “non-Covid19” times to avoid declinations in data sets caused by the traffic situations thus imposed. The indicators’ setting within the NSA instrument shall in its essence represent the mid- or long-term targets that can repeatedly and comparably be assessed through their constellation. Data captured in the extraordinary situations, such as pandemic circumstances might be an interesting polygon for various empirical examinations, but is undesired by the studies that shall build methodologies on “most normal” or common situations on the long run.

By conducting additional analyses, we will further strive to find or modify the most narrative or descriptive indicators for NSA assessment purposes – in relation to location-data availability and prospects – to allow us to best classify the neighbourhoods, while also establishing a connection between mobility-related parameters on one hand and key quality/sustainability indicators on the other. Further steps include mutual capturing and reuse of the vehicles counts database, gathered from the radar-count points at the selected routes. This will be done for the validation purposes and to correlate the vehicle volumes on certain route sections with the travel time values at the same time. If found consistent, the combination of these two types of data can play a key role in fixing the possible data gaps, and making the advances on the interchangeable data sets, which is also one of the important objectives of this research.

Another potential and complementary data set existent and available for use are the travel times and reliability of public transport on the same routes. Indicators, combining both, car-based and public transport times and their reliability would bring significant insight into the travel patterns, and more holistic understanding of the possibilities that residents have as regards connectivity of their neighbourhoods.

5. Conclusion

Given the ongoing debate on the optimal structure of NSA tools, their thematic coverage and indicators assortment in the assessment scheme, perhaps the most important question recurring in our research is: are the metrics proposed a true reflection of the issues and challenges that concern neighbourhoods and associated communities and people. The endorsed relevance of the particular observed variable/indicator is therefore an important step in ranking it among others in the NSA framework, thereby increasing the assessment efficiency, feasibility and slickness.

The objective of this research project is to contribute with a consistent methods by which a compact and robust indicators of QoL can be calculated and interpreted, however based on the key features, these are, existence, availability and possible reuse of data sets applicable and relevant for the assessment.

The ways in which urban design and planning issues are addressed in contemporary, shifting conditions is strongly associated with how spatial issues are framed, detected and analysed. Recognition of the different conceptual perspective in relation to the data requirements and opportunities compared to existing procedures obviously sheds light on the potential held by mobile location data. This has come about both from the user perspective in the manifestation of how the connectivity or accessibility characteristics are experienced, and from the perspective of urban planning and management in the expression of how the features of connectivity or accessibility build the travel patterns, which further impacts the environment and local economies.

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